

# VEGETATION AND FLORA OF AMERICAN BEECH WOODS NATURE PRESERVE, CLARK COUNTY, ILLINOIS

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## ABSTRACT

American Beech Woods Nature Preserve is located on Illinoian till in the Wabash Border Division of eastern Illinois. The plant life of this 8 ha site was examined during the 1999–2001 growing seasons. We documented a total of 207 vascular plant species in 148 genera of 71 families (10 pteridophytes, 1 gymnosperm, 49 monocots, and 147 dicots). We also sampled the vegetation using a stratified-random line-strip method. Tree density averaged 249 trees/ha with a basal area of 22.91 m<sup>2</sup>/ha. *Fagus grandifolia* Ehrh. (American beech) was the dominant tree species with 63 trees/ha, a basal area of 7.34 m<sup>2</sup>/ha, and an importance value 26.1 (possible 100). *Acer saccharum* Marsh. (sugar maple) ranked second in importance value (IV = 15.7) with most individuals in the 10–19.9 cm diameter class. *Quercus velutina* Lam. (black oak) and *Carya glabra* (Mill.) Sweet (pignut hickory) were the only other over-story trees with an importance value greater than 10. In comparison with an earlier study in 1973, the site has experienced a decrease in both tree density (399 trees/ha vs. 249 trees/ha) and basal area (33.35 m<sup>2</sup>/ha vs. 22.91 m<sup>2</sup>/ha).

## RESUMEN

La Reserva Natural de Haya Americana está ubicada en terreno Illinois en la frontera del Río Wabash en Illinois oriental. La flora del bosque que mide 8 hectáreas fue examinada durante la temporada de crecimiento en los años 1999–2001. Hemos identificado 207 especies de plantas vasculares que incluyen 148 géneros de 71 familias distintas: 10 pteridófitas, una gimnosperma, 49 monocotiledóneas, y 147 dicotiledóneas. Muestreamos la vegetación usando el método de línea-franja aleatoria. La densidad promedio era 249 árboles por hectárea con una área basal de 22.91 m<sup>2</sup>/ha. *Fagus grandifolia* Ehrh. (haya) era la especie de árbol dominante. Había 63 árboles por hectárea con una área basal de 7.32 m<sup>2</sup>/ha y un valor de importancia de 26.1 (posibilidad de 100). *Acer saccharum* (arce de azúcar) tenía una importancia secundaria con un valor de importancia de 15.7. La mayoría de los individuos pertenecían a la clase de tamaño entre 10–19.9 cm. *Quercus velutina* Lam. (roble negro) y *Carya glabra* Mill. (nuez de cerdo) eran los únicos árboles que tenían un valor de importancia de más de 10. En comparación con el estudio de 1973 el bosque ha sufrido una pérdida de densidad (399 árboles por ha v. 249 árboles por ha) y área basal (33.35 m<sup>2</sup>/ha v. 22.91 m<sup>2</sup>/ha).

## INTRODUCTION

At the beginning of extensive European settlement (ca. 1800), about 61% of Illinois was prairie and savanna. The remainder, mostly the more rugged terrain, was woodland and forest (Küchler 1964; Anderson 1970; Iverson et al. 1991; Ebinger 1997). In such areas of rugged terrain, tree species composition varied

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locally with oaks (*Quercus* spp.) and hickories (*Carya* spp.) being the common forest species on drier mostly upland sites. Mesophytic species such as elm (*Ulmus* spp.), ash (*Fraxinus* spp.), and sugar maple (*Acer saccharum* Marsh.) were associated with the dissected ravines and narrow river floodplains (Braun 1950; Anderson 1983; Cowell & Jackson 2002). At the eastern edge of Illinois, particularly in the Wabash Border Natural Division, many of these forests contained American beech (*Fagus grandifolia* Ehrh.), tulip tree (*Liriodendron tulipifera* L.), and other tree species typically found in forests to the east of Illinois (Schwegman 1973). American beech has a wide range comparable to that of other major Eastern Deciduous Forest trees.

Beech-maple forests usually included some species of oaks and hickories and reached the western limit of their range in east-central and southern Illinois. In Illinois, the few remaining examples of this community type are associated with steep, deeply dissected ravine systems, narrow valleys, and narrow to broad ridges. The beech-maple component has a rich herbaceous layer on the mesic slopes and an oak-hickory component on the ridges and more level uplands. These remnants have been variously disturbed by logging, grazing, and exotic species invasion.

Three examples of this forest community located in the Wabash River Valley have been dedicated as Illinois Nature Preserves (McFall & Karnes 1995). Occurrences of American beech in this region have enhanced significance as these populations represent the western edge of the range of a wide ranging eastern North American species. The American Beech Woods Nature Preserve contains one of these protected beech-maple forests. The objectives of our study were to document the vascular flora; to determine the composition and structure of the woody and herbaceous vegetation; and to analyze changes in the forest composition that occurred since the forest was last studied in 1973.

#### DESCRIPTION OF THE STUDY AREA

The American Beech Woods Nature Preserve, dedicated as a nature preserve in 1985, is located in Lincoln Trail State Park (Fig. 1), about 5 km south of Marshall, Clark County, Illinois (SE/4, NW/4, S2, T10N, R12W; 39°20'30"N, 87°42'45"W). Located in the Southern Upland Section of the Wabash Border Natural Division about 15 km from the Indiana state line, the preserve is situated on Illinoian glacial till about 20 km south of the terminal moraine of Wisconsin glaciation (Schwegman 1973). The preserve, about 8 ha in size, has rugged topography, ranging in elevation from 167 m at the edge of Lincoln Trail Lake to 190 m at the highest point. Topographic features include steep-sided ravines, valley walls of various slope aspects, and narrow ridges. The western boundary of the preserve follows the shoreline of Lincoln Trail Lake. Presently most of the preserve is high quality, old second growth, mesic and dry-mesic upland forest (White & Madany 1978). Based on the original Government Land Office survey records

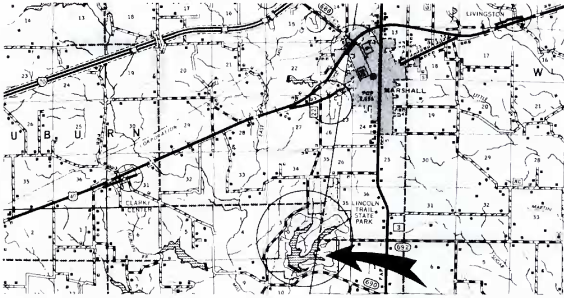


FIG. 1. The location of Clark County in eastern Illinois, and the location of American Beech Woods Nature Preserve in Lincoln Trail State Park, S of Marshall, Illinois (courtesy of the Illinois Nature Preserves Commission).

at the Illinois State Archives in Springfield (Hutchison 1988), the woods still retains many of the species present prior to settlement by Europeans.

The overstory of the preserve was sampled in 1973 as part of an extensive study that examined the structure and composition of beech-maple forests in Illinois, Indiana, Michigan, and Wisconsin (Dunn 1978). Two prescribed burns (Nov 1993 and Dec 1998) have been conducted in the preserve, while seedlings and saplings of sugar maples have been removed recently from the flat uplands and ridgetops.

The soils of the ridgetops are Stoy silt loam, a somewhat poorly drained soil that formed in loess underlain by Illinoian glacial till (Awalt 1979). Soils of the wooded slopes and drainages are Hickory loam, a well-drained soil that developed in Illinoian glacial till. These soils overlay bedrock composed of Pennsylvanian shale and sandstone (Dunn 1978).

The climate is continental, characterized by hot, humid summers and cold winters. Weather station records for Marshall, Illinois, about 6 km north of the preserve, indicate that the area receives an average annual precipitation of 104 cm which falls mostly as rain during the period of April through September (Weather.com 2002). January is the coldest month with an average high temperature of 1° C and an average low temperature -8° C. The record high for the month was 27° C on January 9, 1932 and the record low was -31° C on January 18, 1930. July is the hottest month with an average high temperature of 31° C and an average low of 17° C. The record high for the month was 43° C on July 14, 1936 and the record low was 7° C on July 1, 1937 (weather.com 2002).

## MATERIALS AND METHODS

The area was visited numerous times during the 1999, 2000, and 2001 growing seasons. During each trip, all new flowering or fruiting species encountered were collected, the specimens identified, and deposited in the Stover-Ebinger Herbarium (EIU) of Eastern Illinois University, Charleston. Native status and nomenclature follows Mohlenbrock (2002). All vascular plant taxa observed are enumerated in the Annotated Species List (Appendix I).

Vegetation sampling to determine quantitative abundance of woody and herbaceous species was conducted on August 29 and 30, 2000. We employed the stratified-random line-strip method of Lindsay (1955) as modified by Donselman (1973), Levenson (1973), and Dunn (1978). Using this method, overstory trees, saplings, shrubs, and ground layer strata were sampled simultaneously in rectangular plots positioned along transect lines.

Sample plots for the overstory trees ( $\geq 10.0$  cm dbh) were delimited using a 100 m tape divided into 25 m sections. Overstory trees were sampled in 10 m  $\times$  25 m (0.025 ha) with four located along each transect. All trees whose centers were located within the plots were included in the sample. Aspect of the plot, species, and diameter at breast height (dbh) were recorded for each individual located within the boundaries of each plot. Large saplings (5.0 cm dbh – 9.9 cm dbh), intermediate saplings ( $\geq 2.5$  cm dbh;  $\leq 4.9$  cm dbh), small saplings ( $\geq 50.0$  cm tall;  $\leq 2.4$  cm dbh), shrubs, and the groundlayer (woody seedlings  $< 50.0$  cm tall and all herbaceous taxa) were sampled in rectangular plots located at the zero, 25 m, 50 m, and 75 m mark of the tape. Aspect, species, and the number of individuals were recorded for all vascular plants in each category that fell within one meter from the tape along a section 2.5 m long (0.00025 ha plot).

When all plots along the 100 m transect line were sampled, a section of 1/2" steel conduit marked "Edgin 2000" was driven at each end of the tape to facilitate the relocation of the transect line for future studies. A new 100 m transect line, located a minimum of 25 m distant from the first line and perpendicular to the ravine was then established and the sampling procedures repeated. This process was replicated along ten 100 m transect lines providing a total of 40 plots in each category.

Density (trees/ha), basal area ( $m^2/ha$ ), frequency (%), relative density, relative dominance, relative frequency, importance value (relative density + relative dominance + relative frequency/3) and average basal area were determined for each species in the overstory tree stratum. Density (stems/ha), frequency (%), relative density, relative frequency, and importance value (relative density + relative frequency/2) were determined for each species in the small, intermediate, and large sapling, shrub, and ground layer strata.

The Floristic Quality Index (FQI) of the site was determined using the Coefficient of Conservatism (CC) assigned to each species by Taft et al. (1997). The

CC for each species in the Illinois flora was determined by assigning an integer from 0 to 10 for each species based on its tolerance to disturbance and its fidelity to habitat integrity. The FQI is a weighted index of species richness ( $N$  = number of species present), and is the arithmetic product of the average Coefficient of Conservatism (C-Value = the average of all species CC's) multiplied by the square root of the species richness ( $\sqrt{N}$ ):  $FQI = C\text{-Value}(\sqrt{N})$ . Therefore the FQI indicates the level of habitat degradation and provides an assessment of the quality of each tract based on the taxa present. It is particularly useful when combined with quadrat-based sampling methods and provides a way of making quantitative comparisons among sites. The Sørensen Coefficient of Community (Sørensen 1948) was used to determine the similarity of the ground layer vegetation on the different slope aspects in the study area. The index is calculated as  $2c/(a + b + 2c)$ , where  $a$  is the number of species unique to sample  $a$ ,  $b$  is the number of species unique to sample  $b$ , and  $c$  is the number of species shared by both samples (Small & McCarthy 2001).

#### RESULTS AND DISCUSSION

**Overstory and woody understory composition and structure.**—During the sampling of the overstory, a total of 17 tree species was encountered, including two understory species having little chance of reaching the canopy; seven additional tree species were found elsewhere on the preserve, i.e., outside the sampling transects, accounting for a total of 24 species. Overall tree density was 249.0 trees/ha and total basal area was 22.91 m<sup>2</sup>/ha. American beech ranked first in basal area, relative density, relative dominance, and importance value (Table 1). It was the most frequently encountered species, occurred in 70% of the plots, and was evenly distributed throughout most diameter classes. Sugar maple ranked second in importance value and relative density and third in basal area. It occurred in 57.5% of the plots and was most abundant in the smaller diameter classes with 63% of the individuals encountered being in the 10–19.9 cm diameter class. *Quercus velutina* Lam. (black oak) (IV = 11.7) and *Carya glabra* (Mill.) Sweet (pignut hickory) (IV = 10.0) were the only other taxa encountered with importance values greater than 10. Black oak was most abundant in the medium and large diameter classes while pignut hickory was most abundant in the smaller diameter classes.

Of the remaining overstory trees, tulip tree was the only species to be represented in most diameter classes, being present in low numbers in all but the largest diameter class (Table 1). *Carya ovata* (Mill.) K. Koch (shagbark hickory) was present only in the smaller diameter classes with no individuals over 39.9 cm dbh being encountered. *Carya tomentosa* (Poir. ex Lam.) Nutt. (mockernut hickory) was present in low numbers in the small and medium diameter classes while *Quercus alba* L. (white oak) was present only in the medium diameter

TABLE 1. Density (#/ha) by diameter classes (cm), total density (#/ha), basal area (m<sup>2</sup>/ha), frequency (%), relative density, relative dominance, relative frequency, importance value, and average dbh are given for tree taxa encountered during sampling of American Beech Woods Nature Preserve, Clark County, Illinois. Also included is the importance value and average dbh per tree taxa from the 1973 study (Dunn 1978).

									Total	Basal						Avg.	1973	
	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0+	Density	Area	Freq.	Rel.	Rel.	Rel.	IV	Area/	1973	Area/
	-19.9	-29.9	-39.9	-49.9	-59.9	-69.9	-79.9		(#/ha)	(m <sup>2</sup> /ha)	(%)	Den.	Dom.	Freq.	IV	tree	IV	tree
<i>Fagus grandifolia</i>	16.0	12.0	12.0	10.0	8.0	4.0	--	1.0	63.0	7.34	70.0	25.3	32.0	21.1	26.1	0.12	25.9	0.09
<i>Acer saccharum</i>	29.0	6.0	4.0	5.0	--	2.0	--	--	46.0	2.59	57.5	18.5	11.3	17.3	15.7	0.06	15.5	0.06
<i>Quercus velutina</i>	--	4.0	9.0	6.0	2.0	3.0	1.0	--	25.0	3.72	30.0	10.0	16.2	9.0	11.7	0.15	7.3	0.13
<i>Carya glabra</i>	12.0	7.0	8.0	2.0	1.0	--	--	--	30.0	1.87	32.5	12.1	8.2	9.8	10.0	0.06	4.3	0.08
<i>Liriodendron tulipifera</i>	3.0	3.0	4.0	2.0	1.0	1.0	1.0	--	15.0	1.80	25.0	6.0	7.9	7.5	7.1	0.12	5.4	0.18
<i>Carya ovata</i>	11.0	9.0	4.0	--	--	--	--	--	24.0	0.95	25.0	9.6	4.1	7.5	7.1	0.04	0.8	0.02
<i>Carya tomentosa</i>	4.0	2.0	2.0	3.0	1.0	1.0	--	--	13.0	1.02	20.0	5.2	4.5	6.0	5.2	0.08	4.1	0.06
<i>Quercus alba</i>	--	--	4.0	1.0	1.0	1.0	--	--	7.0	1.12	17.5	2.9	4.9	5.3	4.4	0.16	11.0	0.11
<i>Quercus rubra</i>	--	--	--	--	1.0	1.0	--	1.0	3.0	1.06	10.0	1.2	4.6	3.0	2.9	0.36	8.2	0.14
<i>Ulmus americana</i>	6.0	1.0	--	--	--	--	--	--	7.0	0.13	10.0	2.8	0.6	3.0	2.1	0.02	0.4	0.03
<i>Fraxinus pennsylvanica</i>	--	1.0	--	2.0	--	--	--	--	3.0	0.44	7.5	1.2	1.9	2.2	1.8	0.15	0.7	0.11
<i>Nyssa sylvatica</i>	--	--	3.0	--	--	--	--	--	3.0	0.29	7.5	1.2	1.3	2.2	1.6	0.10	6.2	0.04
<i>Ulmus rubra</i>	1.0	1.0	--	1.0	--	--	--	--	3.0	0.22	7.5	1.2	1.0	2.2	1.5	0.08	--	--
<i>Sassafras albidum</i>	3.0	--	--	--	--	--	--	--	3.0	0.04	5.0	1.2	0.2	1.5	1.0	0.01	0.7	0.09
<i>Acer rubrum</i>	--	--	--	--	1.0	1.0	--	--	2.0	0.23	2.5	0.4	1.0	0.8	0.9	0.23	--	--
<i>Juglans nigra</i>	--	--	1.0	--	--	--	--	--	1.0	0.08	2.5	0.4	0.3	0.8	0.5	0.09	--	--
<i>Cornus florida</i>	1.0	--	--	--	--	--	--	--	1.0	0.01	2.5	0.4	0.0	0.8	0.4	0.01	0.8	0.01
Others (7 taxa)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8.7	--
Totals	86.0	46.0	51.0	32.0	16.0	14.0	2.0	2.0	249.0	22.91		100.0	100.0	100.0	100.0		100.0	

classes. Of the remaining trees, most were present as widely scattered individuals with two, *Sassafras albidum* (Nutt.) Nees (sassafras) and *Cornus florida* L. (flowering dogwood) being understory trees.

The overall tree density declined from 399.0 trees/ha in 1973 to 249.0 trees/ha in this study (Dunn 1978) (Table 1). Total basal area also decreased from 33.35 m<sup>2</sup>/ha in 1973 to 22.91 m<sup>2</sup>/ha in 2000. However, the importance values for American beech, sugar maple, and most other species were very similar to those reported in the previous study. The importance value of shagbark hickory was considerably higher in the present study while those of white oak and red oak were considerably lower.

Seven species having a combined importance of 8.7 in the 1973 study were not encountered during the sampling in this study. Of those species, *Carya cordiformis* (Wang.) Koch (bitternut hickory) and *Fraxinus americana* L. (white ash) had IV's totaling 1.5 in the 1973 study. *Amelanchier arborea* (Michx. f.) Fernald (shadbush), *Carpinus caroliniana* Walt. (musclewood), and *Ostrya virginiana* (Mill.) K. Koch (ironwood) are understory trees that had a combined importance value of 4.8 in the 1973 study. Since no permanent transects were established in the previous study, these changes may be more reflective of sampling error rather than changes in the composition of the forest stand. *Tilia americana* L. (basswood) (IV = 2.4 in 1973) was encountered neither during the sampling, nor the site visits and appears to have been extirpated from the preserve.

In the understory, sugar maple and American beech ranked first and second, respectively in all three sapling categories. Of the remaining understory trees, only flowering dogwood and ironwood were present in all of the sapling categories (Table 2). Hickories were not common in the understory and no oaks were encountered.

A total of 26 dead-standing saplings were encountered in 11 plots. These stems were all in the medium and small sapling categories and occurred in plots located on ridgetops or slopes with an east, west, or southwest aspect. Of 26 stems encountered, 19 appeared to have been top-killed by fire (14 sugar maple, two ironwood, two American beech, and one hickory). Seven dead-standing dogwood saplings were encountered, but it was not clear as to whether these individuals were dead as a result of fire or anthracnose.

*Hydrangea arborescens* L. (wild hydrangea) and *Lonicera maackii* (Rupr.) Maxim. (bush honeysuckle) were the only shrub taxa encountered. Wild hydrangea was present in one plot located in a creek bottom while one bush honeysuckle shrub was encountered in a plot with a north-facing aspect.

**Groundlayer composition and structure.**—A total of 70 taxa was encountered in the groundlayer (Table 3). The *Carex* spp. (sedges) as a group ranked first in importance value (IV = 8.8) and occurred in 50% of the plots. *Pilea pumila* (L.) A. Gray (clearweed) ranked second in importance value, being most abundant in plots that occurred in creek bottoms and on the northeast-facing slopes. *Sanicula*

TABLE 2. Density (stems/ha) arranged by aspect, total density (#/ha), frequency (% of plots in which each taxon was observed), relative density, relative frequency, and importance value for large saplings ( $\geq 5.0$  cm dbh– $9.9$  cm dbh), intermediate saplings ( $\geq 2.5$  cm dbh– $< 5.0$  cm dbh), and small saplings ( $> 50$  cm tall– $2.5$  cm dbh) encountered during sampling of American Beech Woods Nature Preserve, Clark County, Illinois.

	Aspect									All plots				
	Crk. Bot.	SW	Ridge top	N	W	Large Saplings (5–10cm dbh)				Total Density (#/ha)	Freq. (%)	Rel. Den.	Rel. Freq.	IV
<i>Acer saccharum</i>	--	114	66	198	--	400	400	--	--	130	17.5	65.0	46.7	55.9
<i>Fagus grandifolia</i>	57	--	--	66	80	--	--	--	--	30	7.5	15.0	20.0	17.5
<i>Carpinus caroliniana</i>	114	--	--	--	--	--	--	--	--	20	5.0	10.0	13.3	11.7
<i>Cornus florida</i>	--	57	--	--	--	--	--	--	--	10	5.0	5.0	13.3	9.1
<i>Carya ovata</i>	--	--	--	--	--	--	--	--	--	10	2.5	5.0	6.7	5.8
<b>Totals</b>	171	171	66	264	80	400	400	--	--	200		100.0	100.0	100.0
<b>Intermediate Saplings (2.5–4.9 cm dbh)</b>														
<i>Acer saccharum</i>	228	--	198	132	--	400	133	800	400	200	30.0	52.6	46.3	49.4
<i>Fagus grandifolia</i>	57	160	66	198	160	--	266	--	400	120	22.5	31.7	34.6	33.2
<i>Cornus florida</i>	--	--	132	--	80	--	--	--	--	30	5.0	7.9	7.7	7.8
<i>Carpinus caroliniana</i>	--	--	--	--	80	--	--	--	--	10	2.5	2.6	3.8	3.2
<i>Ulmus rubra</i>	--	--	--	--	--	80	--	--	--	10	2.5	2.6	3.8	3.2
<i>Carya ovata</i>	--	80	--	--	--	--	--	--	--	10	2.5	2.6	3.8	3.2
<b>Totals</b>	285	240	396	330	320	480	399	800	800	380		100.0	100.0	100.0
<b>Small Saplings (&gt;50 cm tall–2.4 cm dbh)</b>														
<i>Acer saccharum</i>	513	720	462	924	--	80	266	3200	800	600	47.5	43.4	31.1	37.3
<i>Fagus grandifolia</i>	456	320	66	330	320	--	133	200	--	240	37.5	17.4	24.5	20.9
<i>Ostrya virginiana</i>	--	--	--	528	80	--	--	400	400	120	12.5	8.7	8.2	8.5
<i>Ulmus rubra</i>	114	80	--	66	--	--	--	800	--	90	15.0	6.5	9.9	8.2
<i>Cornus florida</i>	57	80	198	66	80	--	--	--	--	70	15.0	5.1	9.9	7.5
<i>Asimina triloba</i>	--	--	--	--	--	1280	--	--	--	160	2.5	11.6	1.6	6.6



TABLE 2. continued

	Aspect									All plots				
	Crk. Bot.	SW	Ridge top	N	W	E	S	NE	SE	Total Density (#/ha)	Freq. (%)	Rel. Den.	Rel. Freq.	IV
<i>Carpinus caroliniana</i>	57	--	--	--	80	--	--	--	--	20	5.0	1.5	3.4	2.5
<i>Fraxinus pennsylvanica</i>	57	--	--	66	--	--	--	--	--	20	5.0	1.5	3.4	2.5
<i>Prunus serotina</i>	--	--	--	--	--	--	--	400	--	20	2.5	1.5	1.6	1.6
<i>Liriodendron tulipifera</i>	--	--	--	--	--	--	--	200	--	10	2.5	0.7	1.6	1.1
<i>Morus rubra</i>	--	--	--	--	--	--	--	200	--	10	2.5	0.7	1.6	1.1
<i>Sassafras albidum</i>	--	--	--	66	--	--	--	--	--	10	2.5	0.7	1.6	1.1
<i>Fraxinus americana</i>	--	--	--	66	--	--	--	--	--	10	2.5	0.7	1.6	1.1
<b>Totals</b>	1254	1200	726	2112	560	1360	399	5400	1200	1380		100.0	100.0	100.0

TABLE 3. Density (#/ha) arranged by aspect, total density (#/ha), frequency (% of plots in which each taxon was observed), relative density, relative frequency, and importance value for groundlayer taxa including woody species (&lt;50 cm tall) encountered during sampling of American Beech Woods Nature Preserve, Clark County, Illinois.

	Aspect									All plots				
	Crk. Bot.	SW	Ridge top	N	W	E	S	NE	SE	Density (#/ha)	Freq. (%)	Rel. Den.	Rel. Freq.	IV
<i>Carex</i> spp.	9324	2880	25974	13320	1332	--	6660	2000	--	14100	50.0	10.4	7.2	8.8
<i>Pilea pumila</i>	46620	--	1998	1332	--	--	333	70000	--	14600	22.5	10.8	3.3	7.0
<i>Sanicula</i> spp.	1332	--	2664	666	22644	800	4662	28000	--	10500	30.0	7.7	4.3	6.0
<i>Asarum canadensis</i>	--	--	--	87246	--	800	4662	--	--	14600	7.5	10.8	1.1	5.9
<i>Viola sororia</i>	11988	800	10656	666	4995	4000	1998	1400	--	7800	35.0	5.7	5.1	5.4
<i>Liriodendron tulipifera</i>	888	7200	1998	3996	999	800	7326	--	--	4500	35.0	3.3	5.1	4.2
<i>Solidago caesia</i>	--	8800	7992	9324	333	--	333	18000	--	4800	32.5	3.5	4.7	4.1
<i>Impatiens capensis</i>	11544	--	--	6660	2664	--	333	2000	--	4600	20.0	3.4	2.9	3.1

TABLE 3. continued

	Crk. Bot.	SW	Ridge top	Aspect						All plots				
				N	W	E	S	NE	SE	Density (#/ha)	Freq. (%)	Rel. Den.	Rel. Freq.	IV
<i>Acer saccharum</i>	1332	1600	7326	1998	333	3200	333	-	--	2500	30.0	1.8	4.3	3.0
<i>Polystichum acrostichoides</i>	1332	1600	666	1332	--	--	333	8000	16000	1700	27.5	1.3	4.0	2.7
<i>Sassafras albidum</i>	--	8800	4662	--	333	1600	333	--	--	2200	22.5	1.6	3.3	2.5
<i>Parthenocissus quinquefolius</i>	1776	3200	666	6660	--	1600	--	--	--	2200	20.0	1.6	2.9	2.3
<i>Arisaema triphyllum</i>	444	4800	1998	--	--	12000	333	--	--	2600	17.5	1.9	2.5	2.2
<i>Ageratina altissima</i>	2664	--	7326	666	--	800	--	2000	--	2000	20.0	1.5	2.9	2.2
<i>Leersia virginica</i>	20424	--	--	--	--	--	--	--	--	4600	7.5	3.3	1.0	2.1
<i>Antennaria virginiana</i>	11544	--	--	--	999	--	--	2000	--	4000	10.0	2.9	1.4	2.1
<i>Phryma leptostachya</i>	1776	800	666	--	1332	--	--	32000	--	2600	15.0	1.9	2.2	2.1
<i>Galium concinnum</i>	444	--	1332	--	333	--	333	40000	--	2500	15.0	1.8	2.2	2.0
<i>Ulmus rubra</i>	444	800	2664	--	--	3200	666	--	--	1200	20.0	0.9	2.9	1.9
<i>Fraxinus americana</i>	888	800	2664	--	--	--	333	2000	--	900	20.0	0.7	2.9	1.8
<i>Osmorhiza claytonii</i>	1332	--	666	330	--	5600	--	--	--	1600	15.0	1.2	2.2	1.7
<i>Laportea canadensis</i>	8436	2400	--	--	--	1600	--	--	--	2400	7.5	1.8	1.1	1.4
<i>Prunus serotina</i>	--	--	1998	3330	--	--	1332	--	--	900	12.5	0.7	1.8	1.3
<i>Aster</i> spp.	888	--	666	--	--	800	--	2000	--	600	15.0	0.4	2.2	1.3
<i>Carya</i> spp.	--	3200	3996	--	--	--	--	--	--	1000	12.5	0.7	1.8	1.3
<i>Equisetum arvense</i>	12432	--	--	1332	--	--	--	--	--	2800	2.5	2.0	0.4	1.2
<i>Vitis aestivalis</i>	--	--	--	666	--	--	8325	--	--	2500	2.5	1.8	0.4	1.1
<i>Oxalis</i> spp.	9768	--	--	--	--	--	--	--	--	2200	5.0	1.6	0.7	1.1
<i>Galium circaezans</i>	--	--	4662	--	999	--	--	2000	--	1100	7.5	0.8	1.1	1.0
<i>Hepatica acutiloba</i>	--	--	--	--	--	--	--	--	8000	1800	5.0	1.3	0.7	1.0
<i>Muhlenbergia</i> spp.	--	--	7326	--	2331	--	--	--	--	1800	5.0	1.3	0.7	1.0
<i>Cornus florida</i>	--	--	666	--	--	--	--	--	--	100	2.5	0.1	0.4	0.3
Others (39 taxa)	12876	16000	7992	7326	3996	12800	5661	3200	800	12800	140.0	9.5	20.3	14.9
<b>Totals</b>	170496	63680	109224	146850	43623	49600	44289	214600	24800	136100		100.0	100.0	100.0

TABLE 4. Ranking of tree species by importance value for plots that occurred on 9 slope aspects at American Beech Woods Nature Preserve, Clark County, Illinois. The species listed are those with the 10 highest overall importance values throughout the preserve and are arranged by descending importance value. Ranking by importance value for each aspect is in parentheses.

Species	Aspect					All plots		
	Creek Bottom (7 plots)	Southwest (7 plots)	Ridge top (5 plots)	North (5 plots)	South & Southeast (5 plots)	West (4 plots)	East (4 plots)	Northeast (3 plots)
<i>Fagus grandifolia</i>	28.3 (1)	33.9 (1)	10.0 (5)	30.2 (1)	20.4 (2)	26.7 (1)	33.3 (1)	53.7 (1)
<i>Acer saccharum</i>	17.7 (3)	19.2 (2)	5.4 (7)	16.9 (2)	4.5 (10)	27.2 (2)	15.3 (3)	20.2 (2)
<i>Quercus velutina</i>	—	12.2 (3)	26.5 (1)	6.8 (5)	13.8 (3)	12.1 (3)	—	12.7 (4)
<i>Carya glabra</i>	—	6.8 (6)	23.9 (2)	15.0 (3)	4.8 (9)	9.2 (4)	—	—
<i>Liriodendron tulipifera</i>	28.1 (2)	6.8 (5)	—	5.6 (6)	10.2 (4)	6.3 (5)	—	—
<i>Carya ovata</i>	—	4.0 (7)	8.4 (6)	4.9 (8)	22.0 (1)	9.2 (6)	12.7 (4)	—
<i>Carya tomentosa</i>	5.9 (6)	2.3 (9)	10.3 (4)	—	6.2 (6)	—	4.7 (8)	13.4 (3)
<i>Quercus alba</i>	—	—	10.7 (3)	4.7 (9)	5.9 (7)	—	16.4 (2)	—
<i>Quercus rubra</i>	—	7.2 (4)	—	10.7 (4)	—	—	—	—
<i>Sassafras albidum</i>	2.8 (8)	—	—	—	—	4.5 (7)	—	—

TABLE 5. Sørensen Index for groundlayer taxa encountered during sampling of American Beech Woods Nature Preserve, Clark County, Illinois.

	Creek Bottom (30 taxa)	Southwest (20 taxa)	Ridge top (27 taxa)	North (23 taxa)	West (20 taxa)	East (18 taxa)	South (25 taxa)	Northeast (18 taxa)
Southwest	44.0							
Ridge top	56.1	63.8						
North	49.1	32.6	52.0					
West	36.0	40.0	55.3	41.9				
East	45.8	42.1	48.9	39.0	26.3			
South	43.6	48.9	53.8	50.0	44.4	46.5		
Northeast	50.0	31.6	57.8	39.0	47.4	22.2	41.9	
Southeast (3 species)	6.1	8.7	6.7	15.4	8.7	0	7.1	9.5

spp. (snakeroot), *Asarum canadense* L. (wild ginger) and *Viola sororia* Willd. (woolly blue violet) were the only other herbaceous taxa with IV's greater than five. Snakeroot was most abundant in plots that had a west and northeast aspect while wild ginger was most common on the north-facing slopes. Woolly blue violet was present in low to moderate numbers in most plots. Tulip tree, sugar maple, and sassafras were the most commonly encountered tree seedlings. Oak seedlings were rare with only one seedling being encountered on a north-facing slope.

**Slope aspects.**—Among the overstory trees, American beech ranked first in importance value in plots located on most slope aspects (Table 4). It ranked second in plots with a south or southeast aspect and fifth in plots that occurred on ridge tops. Sugar maple ranked second in importance value in plots having a southwest, north, west, or northeast aspect. Black oak ranked first in plots that occurred on the ridge tops, but no higher than third on the remaining aspects. White oak ranked second and third in plots with an easterly aspect and on the ridge tops, respectively, but was only a minor component or was absent from plots occurring on the remaining aspects. Red oak ranked fourth in plots with a southwest or north aspect and was not encountered in the remaining plots. Among the hickories, shagbark hickory ranked first in plots with a south or southeast aspect while pignut hickory ranked second in plots that occurred on the ridge tops.

The plots located on the ridgetops and the southwest-facing slopes had greatest similarity (63.8% Sørensen Coefficient of Community, Sørensen 1948) (Table 5). Plots located on the southeast-facing slopes were considerably dissimilar to plots located on other slope aspects having Sørensen Coefficient of Community percentages that ranged from 0 to 15.4. These low values may be attributed to the low number of plots with southeast aspects (1) and the low species richness of the plot (3). Most other plots had similarity indices that ranged from 36.1% and 57.8%.

During the study, we observed 207 vascular plant taxa in the study area: 11 ferns, fern allies, and gymnosperms, 49 monocots, and 147 dicots. Of that number, 23 (11.1%) had a Coefficient of Conservatism (CC) of seven or greater and 10 (4.8%) were non-native taxa. The average CC, when calculated for all taxa, was 3.88 and the FQI was 55.8. When calculated for native taxa only, the average CC and FQI were 4.04 and 57.0, respectively. Sites that have an FQI greater than 35 are considered regionally noteworthy, while sites with an FQI greater than 45 are defined as statewide-significant natural areas (Taft et al. 1997).

The composition of American Beech Woods is similar to other beech-maple forests in Illinois and Indiana, having American beech and sugar maple as co-dominants on the mesic slopes with oaks and hickories predominating on the drier slopes or more level uplands (Ebinger 1997; Cowell & Jackson 2002). The decline in overall tree density and total basal area in this preserve is typical of many similar forest stands in the region (Perry & Lindsey 1961; Lindsey &

Schmelz 1964; Barton & Schmelz 1987). Oak density declines as mature individuals die while shade-intolerant and successional species such as tulip tree, ash, and sassafras, persist as minor components because of gap-phase disturbances (Cowell & Jackson 2002).

## APPENDIX I

Vascular flora of American Beech Woods Nature Preserve, Lincoln Trail State Park, Clark County, Illinois arranged alphabetically by taxonomic group. Nomenclature follows Mohlenbrock (2002). Collection numbers with the T prefix are those of Tucker; while the E prefix indicates specimens collected by Ebinger. All specimens were deposited in the Stover-Ebinger Herbarium at Eastern Illinois University, Charleston, Illinois, with some duplicates at ILLS. Taxa preceded by an asterisk (\*) are non-native.

## FERNS AND FERN ALLIES

## ADIANTACEAE

*Adiantum pedatum* L. T11770

## ASPLENIACEAE

*Asplenium platyneuron* (L.) Oakes E29720  
*Cystopteris protrusa* (Blasd.) Weatherby T11750  
*Polystichum acrostichoides* (Michx.) Schott E29605

## EQUISETACEAE

*Equisetum arvense* L. T11736

## OPHIOGLOSSACEAE

*Botrychium dissectum* Spreng. var. *dissectum*  
 E29719  
*Botrychium dissectum* Spreng. var. *obliquum*  
 (Muhl.) Clute E30427  
*Botrychium virginianum* (L.) Sw. E29501  
*Ophioglossum vulgatum* L. E29889

## THELYPTERIDACEAE

*Phlegopteris hexagonoptera* (Michx.) Fée E29604

## GYMNOSPERMS

## CUPRESSACEAE

*Juniperus virginiana* L. E29890

## DICOTYLEDONS

## ACERACEAE

*Acer saccharum* Marsh. E2989  
*Acer rubrum* L. (Observed)

## ANACARDIACEAE

*Toxicodendron radicans* (L.) Kuntze E30232

## ANNONACEAE

*Asimina triloba* (L.) Dunal E30430

## APIACEAE

*Cicuta maculata* L. T 11739  
*Cryptotaenia canadensis* (L.) DC. T11738  
*Osmorhiza claytonii* (Michx.) Clarke T11752  
*Sanicula canadensis* L. var. *canadensis* T11744  
*Sanicula odorata* (Raf.) Pryer & Phillippe E29622

## ARALIACEAE

*Aralia racemosa* L. E30157  
*Panax quinquefolius* L. E29892

## ARISTOLOCHIACEAE

*Aristolochia serpentaria* L. E29618  
*Asarum canadense* L. E29497

## ASTERACEAE

*Ageratina altissima* (L.) R.M. King & H. Robins.  
 E30158  
*Antennaria plantaginifolia* (L.) Richards. E29500  
*Arnoglossum atriplicifolium* (L.) H. Robins. E30233  
*Aster lateriflorus* (L.) Britt. E30437  
*Aster sagittifolius* Wedem. ex Willd. E30438  
*Aster shortii* Lindl. E30436  
*Erechtites hieracifolia* (L.) Raf. E30439  
*Erigeron annuus* (L.) Pers. T11742  
*Erigeron philadelphicus* L. T12047  
*Eupatorium sessilifolium* L. var. *brittonianum* Porter E30159  
*Euthamia graminifolia* (L.) Nutt. ex Cass. E30293  
*Helianthus divaricatus* L. E30160  
*Hieracium gronovii* L. E30235  
*Krigia biflora* (Walt.) Blake T12041  
*Lactuca canadensis* L. E30236

*Prenanthes altissima* L. E30440  
*Senecio glabellus* Poir. E29608  
*Senecio obovatus* Muhl. T12044  
*Solidago caesia* L. E30442  
*Solidago canadensis* L. E30294  
*Solidago nemoralis* Aiton E30443  
*Solidago ulmifolia* Muhl. ex Willd. E30237

**BALSAMINACEAE**

*Impatiens capensis* Meerb. E30161

**BERBERIDACEAE**

*Podophyllum peltatum* L. E29487

**CORYLACEAE**

*Carpinus caroliniana* Walt. var. *virginiana* (Marsh.)  
 Fernald T11775

*Corylus americana* Walt. E29895

*Ostrya virginiana* (Mill.) K. Koch E29897

**BORAGINACEAE**

*Cynoglossum virginianum* L. E29620

*Hackelia virginiana* (L.) I.M. Johnst. E29894

**BRASSICACEAE**

*Dentaria laciniata* Muhl. E29490

**CAESALPINIACEAE**

*Cercis canadensis* L. T11765

**CAMPANULACEAE**

*Campanulastrum americanum* (L.) Small E30162

*Lobelia inflata* L. T11782

*Lobelia siphilitica* L. E30295

**CAPRIFOLIACEAE**

\**Lonicera maackii* (Rupr.) Maxim. E29610

*Sambucus canadensis* L. T 11756

*Symphoricarpos orbiculatus* Moench E30164

*Viburnum prunifolium* L. E29898

**CARYOPHYLLACEAE**

*Silene stellata* (L.) Aiton E30165

**CORNACEAE**

*Cornus florida* L. E29726

**EBENACEAE**

*Diospyros virginiana* L. E29900

**ELAEAGNACEAE**

\**Elaeagnus angustifolia* L. T11773

**EUPHORBIAEAE**

*Acalypha rhomboidea* Raf. E30238

**FABACEAE**

*Amphicarpaea bracteata* (L.) Rickett & Stafleu  
 E30299

*Desmodium nudiflorum* (L.) DC. T11741

*Desmodium paniculatum* (L.) DC. E30298

\**Robinia pseudoacacia* L. E29901

**FAGACEAE**

*Fagus grandifolia* Ehrh. T12051

*Quercus alba* L. E29727

*Quercus imbricaria* Michx. E30296

*Quercus palustris* Muenchh E30433

*Quercus rubra* L. E30434

*Quercus velutina* Lam. T12305

**GENTIANACEAE**

*Frasera carolinensis* Walt. E29904

**GERANIACEAE**

*Geranium maculatum* L. E29492

**HAMAMELIDACEAE**

*Liquidambar styraciflua* L. E30239

**HYDRANGEACEAE**

*Hydrangea arborescens* L. E29903

**HYDROPHYLLACEAE**

*Hydrophyllum virginianum* L. E30168

**HYPERICACEAE**

*Hypericum punctatum* Lam. T11776

**JUGLANDACEAE**

*Carya cordiformis* (Wangenh.) K. Koch E30431

*Carya glabra* (Mill.) Sweet E30301

*Carya ovata* (Mill.) K. Koch E30432

*Carya tomentosa* (Poir.) Nutt. E30300

*Juglans nigra* L. E30241

**LAMIACEAE**

*Collinsonia canadensis* L. E30242

*Lycopus virginicus* L. E30302

*Monarda bradburiana* Beck E29617

\**Prunella vulgaris* L. T11771

*Pycnanthemum tenuifolium* Schrad. E29905

*Scutellaria incana* Biehl. E29906

*Teucrium canadense* L. T11735

**LAURACEAE**

*Sassafras albidum* (Nutt.) Nees T11759

*Lindera benzoin* (L.) Blume T11764

**MAGNOLIACEAE**

*Liriodendron tulipifera* L. E29728

**MENISPERMACEAE***Menispermum canadense* L. E29615**MORACEAE***Morus rubra* L. E30169**NYSSACEAE***Nyssa sylvatica* Marsh. E29908**OLEACEAE***Fraxinus americana* L. E29729*Fraxinus pennsylvanica* Marsh. E30435\**Ligustrum vulgare* L. E29730**ONAGRACEAE***Circaea lutetiana* L. ssp. *canadensis* (L.) Aschers.  
& Magnus E29910**OROBANCHACEAE***Conopholis americana* (L.) Wallr. E29619**OXALIDACEAE***Oxalis stricta* L. E29624*Oxalis violacea* L. E29625**PAPAVERACEAE***Sanguinaria canadensis* L. E29498**PHRYMACEAE***Phryma leptostachya* L. T11760**PHYTOLACCACEAE***Phytolacca americana* L. E29911**POLEMONIACEAE***Phlox divaricata* L. ssp. *laphamii* (Wood) Wherry  
T12045*Polemonium reptans* L. E29731**POLYGONACEAE***Persicaria punctata* (Elliott) Small E30303*Antenoron virginianum* (L.) Roberty & Vautier  
E30170\**Rumex crispus* L. T11767**PORTULACACEAE***Claytonia virginica* L. E29488**RANUNCULACEAE***Actaea pachypoda* Elliott E29616*Hepatica acutiloba* DC. E29496*Ranunculus abortivus* L. E29495*Ranunculus recurvatus* Poir. T12046*Ranunculus septentrionalis* Poir. E29494*Thalictrum dioicum* L. T12034**ROSACEAE***Agrimonia gryposepala* Wallr. E30173*Agrimonia parviflora* Soland. ex Aiton E30243*Agrimonia pubescens* Wallr. E30172*Amelanchier arborea* (Michx. fil.) Fernald T12050*Geum canadense* Jacq. T11761*Geum vernum* (Raf.) Torrey & A. Gray E29629*Potentilla simplex* Michx. E29630*Prunus serotina* Ehrh. E29631\**Rosa multiflora* Thunb. ex Murr. E29628*Rubus allegheniensis* Porter ex L.H. Bailey E29634*Rubus flagellaris* Willd. E29632*Rubus occidentalis* L. T11777*Rubus pensilvanicus* Poir. ex Lam. T11732**RUBIACEAE***Cephalanthus occidentalis* L. T11734*Galium aparine* L. E29489*Galium circaezans* Michx. T11740*Galium concinnum* Torrey & A. Gray E29733*Galium triflorum* Michx. T11743*Houstonia purpurea* L. E29732**SAXIFRAGACEAE***Penthorum sedoides* L. E30244**SCROPHULARIACEAE***Mimulus alatus* Aiton T11774*Pedicularis canadensis* L. E29735*Scrophularia marilandica* L. E30174**ULMACEAE***Ulmus americana* L. T11737*Ulmus rubra* Muhl. T11768**URTICACEAE***Boehmeria cylindrica* (L.) Sw. E30247*Laportea canadensis* (L.) Wedd. E30246*Parietaria pensylvanica* Muhl. ex Willd. E29915*Pilea pumila* (L.) A. Gray E30304**VERBENACEAE***Verbena urticifolia* L. E29917**VIOLACEAE***Viola palmata* L. E29503*Viola pratincola* Greene E29502*Viola sororia* Willd. E29623**VITACEAE***Parthenocissus quinquefolia* (L.) Planch. E30248*Vitis aestivalis* Michx. E30305**MONOCOTYLEDONS****ALISMACEAE***Alisma triviale* Pursh T11733

**ARACEAE**

- Arisaema dracontium* (L.) Schott E29626  
*Arisaema triphyllum* (L.) Schott T12043

**COMMELINACEAE**

- Tradescantia subaspera* Ker T12033  
*Tradescantia virginiana* L. E29505

**CYPERACEAE**

- Carex albicans* Willd. E29510  
*Carex blanda* Dewey E29511  
*Carex cephalophora* Muhl. ex Willd. E29637  
*Carex glaucoidea* Tuckerm. E30176  
*Carex graciliscens* Steudel T12039  
*Carex hirsutella* Mack. E29927  
*Carex hirtifolia* Mack. T12048  
*Carex lurida* Wahl. T11762  
*Carex pensylvanica* Lam. E29509  
*Carex rosea* Schk. ex Willd. T12037  
*Scirpus georgianus* Harper T11763

**DIOSCOREACEAE**

- Dioscorea quaternata* (Walt.) J.F. Gmel. E29925

**JUNCACEAE**

- Juncus tenuis* Willd. T11772  
*Luzula multiflora* (Retz.) Lej. T11753

**LILIACEAE**

- Allium tricoccum* Aiton E29508  
*Smilacina racemosa* (L.) Desf. E29611  
*Trillium recurvatum* Beck E29507  
*Uvularia grandiflora* Sm. E29612

**ORCHIDACEAE**

- Corallorhiza odororhiza* (Willd.) Nutt. (Observed)

*Galearis spectabilis* (L.) Raf. E29926

*Liparis liliifolia* (L.) Rich. E30307

**POACEAE**

- \**Agrostis gigantea* Roth T11766  
*Agrostis hyemalis* (Walt.) BSP. E30230  
*Brachyelytrum erectum* (Schreb.) Beauv. E29918  
*Bromus pubescens* Muhl. T11751  
*Cinna arundinacea* L. E30177  
*Danthonia spicata* (L.) Roem. & Schult. E29721  
*Dichanthelium boscii* (Poir.) Gould & Clark T11748  
*Dichanthelium clandestinum* (L.) Gould T11757  
*Dichanthelium dichotomum* (L.) Gould E29723  
*Dichanthelium lindheimeri* (Nash) Gould T11746  
*Dichanthelium microcarpon* (Muhl.) Mohlenbr. T11747  
*Elymus hystrix* L. E29922  
*Elymus villosus* Muhl. E29921  
*Elymus virginicus* L. E30178  
 \**Festuca arundinacea* Schreb. T11780  
*Festuca subverticillata* (Pers.) Alekseev T12036  
*Glyceria striata* (Lam.) Hitchc. T11754  
*Leersia virginica* Willd. E29923  
*Muhlenbergia schreberi* J.F. Gmel. E30429  
*Muhlenbergia sobolifera* (Muhl.) Trin. E30179  
 \**Poa compressa* L. E30306  
*Poa sylvestris* A. Gray T12049

**SMILACACEAE**

- Smilax tamnoides* L. var. *hispida* (Muhl.) Fernald E30180

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**REFERENCES**

- ANDERSON, R.C. 1970. Distribution of forest and prairie in Illinois about 1820. Illinois Nature Preserves Commission, Rockford (Map.)



- ANDERSON, R.C. 1983. The eastern prairie-forest transition - an overview. In: R. Brewer, ed. Proceedings of the 8th North American Prairie Conference, 1982, Western Michigan University, Kalamazoo. Pp. 86-92.
- AWALT, F.L. 1979. Soil Survey of Clark County, Illinois. U.S. Dept. Agric., Washington, D.C.
- BARTON, J.D. and D.M. SCHMELZ. 1987. Thirty years of growth records in Donaldson's Woods. *Trans. Indiana Acad. Sci.* 96:209-214.
- BRAUN, E.L. 1950. Deciduous forest of Eastern North America. Blakiston Books, Philadelphia.
- COWELL, C.M., and M.T. JACKSON. 2002. Vegetation change in a forest remnant of the eastern presettlement prairie margin, USA. *Nat. Areas Jour.* 22:53-60.
- CONSELMAN, H.M. 1973. An ecological analysis of the shrub stratum of the beech-maple forest type. M.S. Thesis #1085, Indiana State University, Terre Haute, Indiana.
- DUNN, C.P. 1978. An ecological analysis of the tree stratum of the beech-maple forest type. M.S. Thesis #1299, Indiana State University, Terre Haute, Indiana.
- EBINGER, J.E. 1997. Forest communities of the Midwestern United States. In: M.W. Schwartz, ed. Conservation in Highly Fragmented Landscapes, Chapman and Hall, New York. Pp. 3-23.
- HUTCHISON, M. 1988. A guide to understanding, interpreting, and using the public land survey field notes in Illinois. *Natural Areas Jour.* 8: 245-255.
- IVERSON, L.R., G.L. ROLFE, T.J. JACOB, A.S. HODGINS, and M.R. JEFFORDS. 1991. Forests of Illinois. Illinois Council on Forest Development, Urbana, and Illinois Natural History Survey, Champaign, Illinois.
- KUCHLER, A.W. 1964. Potential natural vegetation of the coterminous United States. *Am. Geograph. Soc. Spec. Publ.* 36.
- LEVINSON, J.B. 1973. The herbaceous stratum of the beech-maple forest: A community structure analysis. M.S. Thesis # 1088, Indiana State University, Terre Haute, Indiana.
- LINDSEY, A.A. 1955. Testing the line-strip method against full tallies in diverse forest types. *Ecology* 36:485-495.
- LINDSEY, A.A. and D.V. SCHMELZ. 1964. Comparison of Donaldson's Woods in 1964 with its 1954 forest map of 20 acres. *Trans. Indiana Acad. Sci.* 74:169-177.
- MCFALL, D. and J. KARNES. (eds.). 1995. A directory of Illinois nature preserves. Volume 2. Northwestern, Central, and Southern Illinois. Illinois Department of Natural Resources, Division of Natural Heritage, Springfield, Illinois.
- MOHLENBRÖCK, R.H. 2002. Vascular flora of Illinois. Southern Illinois University Press, Carbondale and Edwardsville, Illinois.
- PETTY, R.O. and A.A. LINDSEY. 1961. Hoot's Woods, a remnant of virgin timber, Owen County, Indiana. *Trans. Indiana Acad. Sci.* 71:320-326.
- SCHWEGMAN, J.E. 1973. Comprehensive plan for the Illinois nature preserves system. Part 2. The natural divisions of Illinois. Illinois Nature Preserves Commission, Springfield, Illinois. 32 pp. + map.
- SMALL, C.J. and B.C. MCCARTHY. 2001. Vascular flora of the Waterloo Wildlife Research Station, Athens County, Ohio. *Castanea* 66:363-382.

- SØRENSEN, T. 1948. A method of establishing groups of equal amplitude in plant sociology based on similarity of species content. Det. Kong. Danske Vidensk. Selsk. Biol. Skr. (Copenhagen) 5:1–34.
- TAFT, J.B., G.S. WILHELM, D.M. LADD, and L.A. MASTERS. 1997. Floristic quality assessment for vegetation in Illinois, a method for assessing vegetation integrity. *Ergenia* 15:1–95.
- WEATHER.COM. 2002. Monthly averages and records for Marshall, Illinois. The Weather Channel.
- WHITE, J. and M.H. MADANY. 1978. Classification of natural communities in Illinois. In: White, J. Illinois Natural Areas Inventory Technical Report. Natural Areas Inventory, Urbana, IL. Pp. 311–357.